Indications for Percutaneous Closure in Adult Congenital Heart Defect

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ABSTRACT

In recent years, advances in transcatheter percutaneous closures for adults with congenital heart defects have paralleled technological improvements, including imaging, arrhythmia management, and percutaneous interventions. Indications for percutaneous closure of congenital heart defects have expanded with the widening range of device shapes and sizes. This review gives a brief outline of accompanied by guidelines, indications for percutaneous closure in adult common congenital heart defects.

Key words: *Congenital heart defects, transcatheter percutaneous closure, atrial septal defect, ventricular septal defect, patent ductus arteriosus*

Konjenital Kalp Defektlerinin Perkütan Kapatma Endikasyonları

ÖZET

Son yıllarda, konjenital kalp defektleri olan yetişkinler için transkateter perkütan kapatmalar için gelişmeler; görüntüleme yöntemelerinde, aritmi tedavisinde, ve perkütan girişimlerdeki teknolojik gelişmelere paralellik göstermektedir. Konjenital kalp defektlerinin perkütan kapatma endikasyonları elimizde farklı ve daha geniş şekil ve boyutlarda cihazların sağlanması ile artmaktadır. Bu derleme, kılavuzlar eşliğinde erişkinde sık görülen doğumsal kalp defektlerinin perkütan yöntemle kapatılması için endikasyonları kısaca özetlemektedir.

Anahtar kelimeler: *Konjenital kalp defektleri, kapalı transkateter perkütanöz, atriyal septal defekt, ventriküler septal defekt, patent duktus arteriyozus*

INTRODUCTION

Congenital heart disease (CHD) occurs in approximately 1% of live births. Approximately 85% percent of infants born with congenital anomalies can now expect to reach adulthood (1,2). It is essential that the defect should be repaired by percutaneous or surgical interventions before the pulmonary hypertension, right-sided heart failure, atrial arrhythmias, or other complications ensue (11, 20). These factors make surgery a high risk; increase the postoperative complications with poorer long term results. In many cases, if timely interventions are not given the case may become inoperable. In recent years, the percutaneous transcatheter therapies is becoming increasingly recognized as an alternative to surgery for a wide range of adults with CHDs such as atrial septal defect (ASD), ventricular septal defect (VSD) and patent ductus arteriosus (PDA). The ESC guidelines and for the management of grown-up congenital heart disease (new version 2010) (1) and ACC/AHA 2008 guidelines for management of adults with congenital heart disease (2) outlines the indications and types of treatment recommended for the most common congenital cardiovascular diseases affecting adults. This article gives a brief outline of accompanied by guidelines, indications for percutaneous closure in adult common congenital heart defects.

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Table 1. *Indications for Percutaneous Closure of Atrial Septal Defects According to the 2008 Guidelines of the American College of Cardiology/American Heart Association*[2]

Indications for percutaneous closure of ASDs	
Right atrial and ventricular dilatation with or without related symptoms	*Class I*
Paradoxical embolism or platypnea-orthodeoxia syndrome	*Class IIa*
Presence of net left-to-right shunt with pulmonary artery pressure less than two thirds of the systemic pressure or pulmonary vascular resistances less than two thirds of the systemic vascular resistances and positive response to pulmonary vasodilators or to test occlusion of the defect	*Class IIb*
Criteria for percutaneous closure	
ASD with a minimum diameter>5 mm and <40 mm on echocardiographic study	
Adequate rims (>5 mm) from the defect toward adjacent structures, including superior and inferior venae	
cavae, coronary sinus, atrioventricular valves, and pulmonary veins	
Contraindications for percutaneous closure	
All the septal defects that are not ostium secundum defects, including ostium primum, sinus venosus, and	
coronary sinus defects	
Percutaneous closure should be avoided in septum that is markedly aneurysmal or has multiple fenestrations,	
in which a scarcity of surrounding tissue is observed	
Other options should be considered in cases of nickel allergy or contraindication for antiplatelet therapy	

Transcatheter Device Closure of Atrial Septal Defect

Atrial septal defect (ASD) accounts for 7–10% of all forms of congenital heart diseases and is the most common form observed in adults (6). Although a significant number of patients with ASD remain asymptomatic until adult age, early diagnosis and treatment of this disease is crucial because they lead to right atrial and ventricular volume load, systemic embolism, arrhythmias, and paradoxic embolism (3, 4). There are several different types of ASD: the secundum ASD (75% of ASDs; located in the region of the fossa ovalis and its surrounding), the primum ASD (15% to 20% of ASDs) positioned inferiorly near the crux of the heart, the sinus venosus ASD (5% to 10% of ASDs) located near the superior vena cava entry or near the inferior vena cava entry, and the uncommon coronary sinus septal defect (less than 1% of

Table 2. *Indications for percutaneous closure of ventricular septal defects according to the 2008 guidelines of the American College of Cardiology/American Heart Association*[2]

Indications for percutaneous closure of VSDs	
QP/QS>2 or signs of left ventricular volume overload	*Class I*
History of infective endocarditis	*Class I*
QP/QS>1.5 and when pulmonary arterial pressure is less than two thirds of the systemic pressure or the pulmonary vascular resistances are less than two thirds of the systemic vascular resistances or there is left ventricular systolic or diastolic dysfunction	*Class IIa*
Criteria for percutaneous closure	
Only type IV VSD or muscular defects are subject to percutaneous closure (IIb), although there is extensive	
experience with type II or perimembranous VSD	
VSD following infarction for which surgery has been ruled out or in cases of postoperative residual shunt	
Adequate rims (>4 mm) from the defect toward the adjacent structures, including the aortic, pulmonary, mitral, and tricuspid valves	
Contraindications for percutaneous closure	
All septal defects that are not muscular, such as type 1 or subpulmonary defects, type III defects, or atrioventricular canal defects. There are doubts concerning type 2 or perimembranous defects	
Perimembranous defects with aortic valve prolapse or a markedly aneurysmal septum should be avoided	
Other options should be considered in cases of nickel allergy or contraindication for antiplatelet therapy	

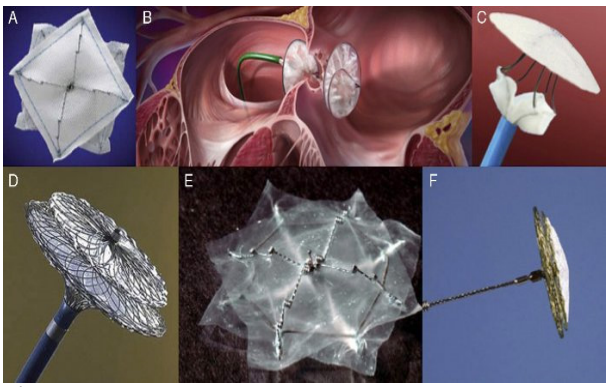

***Figure 1**. Different devices for atrial septal defect and patent foramen ovale closure. (A) CardioSEAL® (NMT Medical; Massachusetts, United States). (B) Helex® (Gore Inc.; Arkansas, United States). (C) STARFlex® Septal Occluder (NMT Medical). (D) Amplatzer® Patent Foramen Ovale Occluder (St. Jude Medical). (E) BioSTAR® Bioabsorbable Septal Occluder (NMT Medical). (F) Figulla® Patent Foramen Ovale Occluder (Occlutech; Sweden).*

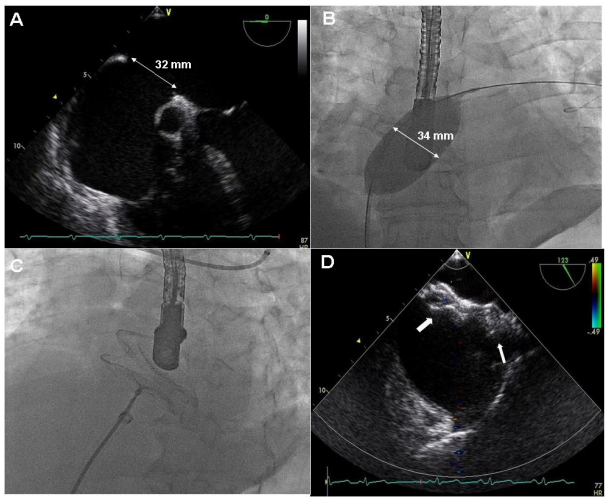

***Figure 2**. In our clinic, large-sized (34 mm) secundum-type ASD (A and B) was closured successfully using the Occlutech device (36 mm) (C and D) with transcatheter method.*

ASDs), which causes shunting through the ostium of the coronary sinus (7). Although surgical closure of an ASD is a frequently offered low-risk procedure, it is associated with some morbidities including postpericardiotomy syndrome, arrhythmia, pericardial-pleural effusion, blood transfusion risks, and scar formation (8). Also, transcatheter closure of ASD has become an important alternative to surgical repair in the management of patients with secundum-type ASD (8, 9). Transcatheter device closure has become first choice for approximately 80% of patients with secundum-type ASD when feasible from morphology (includes stretched diameter, 40 mm and sufficient rim of 5 mm except towards the aorta) (Figure 1) (Table 1). Small ASDs (<5 mm) or patent foramen ovale no evidence of right atrial and ventricular volume overload do not impact the natural history of the individual and thus may not require repair unless related with paradoxical embolism (2). Several recent studies have reported no mortality and serious complications were observed in ≤1% of patients (10, 11). We have been reported that transcatheter ASD closure was successfully performed for 112 (96%) of the 117 patients with secundum-type ASD in our clinic and no mortality and complications were observed (Figure 2) (12).

***Table 3**. Indications for intervention in patent ductus arteriosus according to the ESC Guidelines for the management of grown-up congenital heart disease (new version 2010)[1]*

Class[a]	*Level*[b]	*Indications*
I	*B*	*PDA should be closed in patients with signs of LV volume overload*
I	*C*	*PDA should be closed in patients with PAH but PAP <2/3 of systemic pressure or PVR <2/3 of SVR*
I	*C*	*Device closure is the method of choice where technically suitable*
IIa	*C*	*PDA closure should be considered in patients with PAH and PAP >2/3 of systemic pressure or PVR >2/3 of SV but still net L-R shunt (Qp:Qs >1.5) or when testing (preferably with nitric oxide) or treatment demonstrates pulmonary vascular reactivity*
IIa	*C*	*Device closure should be considered in small PDAs with continuous murmur (normal LV and PAP)*
III	*C*	*PDA closure should be avoided in silent duct (very small, no murmur)*
III	*C*	*PDA closure must be avoided in PDA Eisenmenger and patients with exercise-induced lower limb desaturation*

[a]Class of recommendation. [b]Level of evidence. L-R shunt = left-to-right shunt; LV = left ventricle; PAH = pulmonary arterial hypertension; PAP = pulmonary artery pressure; PDA = patent ductus arteriosus; PVR = pulmonary vascular resistance; Qp:Qs = pulmonary to systemic flow ratio; SVR = systemic vascular resistance.

Transcatheter Device Closure of Ventricular Septal Defect

VSD is the most common congenital heart malformation at birth (30–40%) and presents in approximately 3.0 to 3.5 infants per 1000 live births. Because there is a high incidence of spontaneous closure of small VSDs, the incidence is much less in older infants and particularly in adults (13, 14). There are 4 anatomic types of VSDs; including Perimembranous or paramembranous (most common, about 80% of VSDs), Muscular or trabecular (up to 15–20%), Outlet supracristal or infundibular (approximately 5%), Inlet or AVSD type (typically occurring in Down syndrome) (1, 2). Muscular defects, whether congenital or acquired (caused by trauma or infarction), and postoperative and perimembranous VSD are considered to be treatable with percutaneous closure (Table 2). Whether the risk of complete AV block and entrapment of tricuspid valve tissue leading to tricuspid regurgitation, or the risk of aortic regurgitation that has been observed in children, are relevant in adults remains to be seen. Percutaneous closure is an attractive alternative for patients with congenital heart disease who have undergone multiple surgical operations and have a VSD or a residual VSD. Percutaneous closure is indicated in patients with significant hemodynamic overload without irreversible pulmonary hypertension and in those who have developed endocarditis (2) (Table 2).

Transcatheter Device Closure of Patent Ductus Arteriosus

Patent ductus arteriosus is the persistent communication between the proximal left pulmonary artery and the descending aorta just distal to the left subclavian artery. It can be isolated or may be present in association with all forms of CHD (2). However, in the adult it is usually an isolated finding. Presentations of adult patients with PDA include; Small PDA generally asymptomatic (normal LV volume and normal PAP), moderate PDA may present with left heart failure (with predominant LV volume overload) and may present with right heart failure (with predominant PAH), large PDA may present with differential hypoxemia and differential cyanosis (1). In adults, the anatomy of the PDA is significant for the presence of calcification in the area of the aortic isthmus and pulmonary artery may cause a problem for surgical closure. When a PDA occurs in isolation, device closure is usually feasible and can be successfully performed in the vast majority of adults with a very low complication rate (15, 16). Surgical closure of a PDA in the adult is reserved for the patient with a duct too large for device closure or with inappropriate anatomy and cardiac operations are indicated due to other concomitant cardiac lesions (Table 3).

CONCLUSIONS

In recent years, the growth of transcatheter percutaneous closures for the treatment of adult congenital heart defect has been remarkable. Indications for percutaneous closure of congenital heart defects have expanded with the widening range of device shapes and sizes. Also, percutaneous closures have performed with high success rates and a lower incidence of complications.

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